12-2005

Physical Activity of Older Adults Residing in Different Levels of Care

Randall Joseph Bergman

University of Tennessee - Knoxville

To the Graduate Council:

I am submitting herewith a dissertation written by Randall Joseph Bergman entitled "Physical Activity of Older Adults Residing in Different Levels of Care." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Human Ecology.

Diane A. Klein, Major Professor

We have read this dissertation and recommend its acceptance:

James Neutens, Robert Levey, Deborah Baldwin

Accepted for the Council:

Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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_______Anne Mayhew_______
Vice Chancellor and
Dean of the Graduate Studies

(Original signatures are on file with official student records.)

PHYSICAL ACTIVITY OF OLDER ADULTS RESIDING IN DIFFERENT LEVELS OF CARE

A Dissertation
Presented for the
Doctor of Philosophy
Degree
The University of Tennessee, Knoxville

Randall Joseph Bergman
December 2005

ACKNOWLEDGEMENTS

I would especially like to thank my committee chairperson, Dr. Diane Klein, for her advice and guidance during this project. She kept me on track and focused when I needed it most. I would like to thank Dr. Jim Neutens, Dr. Robert Levey and Dr. Deborah Baldwin for their help and support during this endeavor. Also, I want to thank everyone at Shannondale Retirement Community who assisted me in recruitment, measurement and encouraged me to finish. Last but not least I want to thank myself; it was a long and tireless journey that is finally over. Without everyone's help, assistance and support, this project would not have been an enjoyable learning experience.

ABSTRACT

This study compared the physical activity and functional levels of older adults residing in retirement (RH), assisted-living (AL) and nursing homes (NH). The StepWatch Step Activity Monitor3 (SW) pedometer was used to collect the number of steps taken during one day of activity. Activities of daily living (ADL) and instrumental activities of daily living (IADL) surveys were completed to measure functional status in terms of ADL problems and impairments. The sample consisted of thirty-seven older adults (17 RH, 8 AL, 12 NH, 71 – 94 years old) who wore the SW on the right ankle during a full day of routine activity. ADL and IADL surveys were completed the day prior to the collection of physical activity data. Participants wore the pedometers an average of 13.66 ± 1.26 hours (12.63 ± 1.43 RH, 13.82 ± 1.26 AL, 14.13 ± .84 NH) and took 6134.11 ± 5205.60 steps (8518.47 ± 4707.78 RH, 2592.75 ± 1961.69 AL, 5117.17 ± 5913.01 NH). The average score for ADL problems was 2.32 ± .1.31 (3.42 ± .67 RH, 2.88 ± .99 AL, 1.29 ± .99 NH) and 4.35 ± 1.30 for impairments (5.42 ± .67 RH, 5.00 ± .77 AL, 3.29 ± .99 NH). Data indicates that as level of skilled care increases number of steps taken and functional levels of older adults decrease.

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1. INTRODUCTION

Physical inactivity is associated with increased risk for developing any of a number of degenerative and chronic conditions (e.g. heart disease, diabetes, cancer, stroke, obesity and back pain) (Blair, Kohl, Paffenbarger, Clark, Cooper & Gibbions, 1989; Kaplan, Seeman, Cohen, Knudsen & Guralnik, 1987; Paffenbarger, Hyde, Wing, Lee, Jung & Kampert, 1993; Sandvik, Erikssen, Thaulow, Esikssen, Mundal & Rodahl, 1993). Regular moderate intensity physical activity on most days of the week can reduce the risk for various diseases such as coronary heart disease, obesity, osteoporosis, and Type II diabetes (Booth, Chakravarty, Gordon, Spangenburg, 2002; Jakicic & Gallagher, 2003; U.S Department of Health and Human Services, 1996). In 2002 it is reported that 65% of adults in the United States are reported as overweight, with 31% being considered obese and 40% who do not engage in leisure time physical activity (National Center for Health Statistics, 2004). Although, the benefits of physical activity are widely known (Centers for Disease Control and Prevention, 1999; Mazzeo, Cavanaugh, Evans, Fiatarone, Hagberg, et al., 1998) many people fail to achieve the recommended levels.

There has been a national movement to increase the levels of physical activity in adults and children. Healthy People 2010 has included objectives of increasing participation in physical education classes and leisure time physical activity (Centers for Disease Control and Prevention, 2004). Guidelines developed by the American College of Sports Medicine (ACSM) and the Centers for Disease Control and Prevention (CDC) suggest that adults should accumulate at least 30 minutes of moderate-intensity physical activity on most, if not all days of the week (Pate, Pratt, Blair, Haskell, Macera, Bouchard, et al., 1995). Older adults need to meet this recommendation to reduce the rate of age-associated deterioration of daily function and increase quality of life (Mazzeo, Cavanagh, Evans, Fiatarone, Hagberg, et al., 1999). This recommendation can be met by brisk walking approximately 2 miles per day or walking 10,000 steps per day to meet the current national physical activity guidelines (Feury, 2000; Wahlberg, 2003).

Physical activity is defined as a bodily movement that is produced by the contraction of the skeletal muscles and that substantially increases energy expenditure (American College of Sports Medicine, 2000). Being able to accurately measuring the amount of activity individuals accumulate throughout the day is needed. Methods include self-report, direct observation, accelerometers and pedometers. Currently, pedometers have become a standard tool for measuring physical activity, as well as for motivating individuals participating in exercise intervention studies. Waist-mounted pedometers detect vertical accelerations of the hip that occur during ambulatory activity, and they use this to measure steps taken or distance walked. A spring-suspended lever arm moves up-and-down during walking, which opens and closes an electrical circuit. Studies have reported the accuracy of Yamax pedometers in assessing physical activity at different walking speeds in adults. Crouter, Schneider, Karabulut and Bassett (2003) concluded that pedometer accuracy for counting steps increases at higher walking speeds. Out of ten pedometers tested only the Yamax Digiwalker SW – 701 did not differ from actual steps at five (54, 67, 80, 94 and 107 $m \cdot min^{-1}$) treadmill speeds. Schneider, Crouter, Lukajic and Bassett (2003) noted that the Yamax Digiwalker SW – 701 pedometer displayed values within ± 3% of actual steps taken at self-selected walking speeds ranging from 77.3 to 114.9 $m \cdot min^{-1}$ over a 400 meter walk.

Few studies have assessed the accuracy of electronic pedometers for measuring activity of older adults (65 years of age and older). When tested on nursing home residents, Yamax pedometers significantly underestimated steps taken at slow (25.2 $m \cdot min^{-1}$), normal (38.4 $m \cdot min^{-1}$) and fast paces (48 $m \cdot min^{-1}$) over 13 meters (Cyarto, Myers & Tudor-Locke, 2004). A step activity monitor (SAM) worn at the ankle, was used to assess ambulatory activity in gait-impaired hemiparetic stroke patients. During two separate 6-minute walking trials, the SAM recorded 98% of actual steps (Macko, Haeuber, Shaughness, Coleman, Boone, et al., 2002). Coleman, Smith, Boone, Joseph, and Aguila (1999) observed adults with diabetic peripheral neuropathy over a walking course using the step activity monitor and observed step counts. On two different trials, two weeks apart the step activity monitor recorded 99.7% of steps taken. Bergman, Bassett and Klein (in review) determined that the StepWatch Step Activity Monitor3 (Cyma Incorporated, Seattle, WA), also worn at the ankle, accurately measures steps taken by older adults in an assisted-living facility during a 161 meter walk. In a study that used a step activity monitor for long term activity monitoring (Resnick, Nahm, Orwig, Zimmerman & Magaziner, 2001) the researchers' randomly assigned two participants to wear the device for 6 hours, one for 8 hours and one for 48 hours. Along with wearing the step activity monitor the participants were asked to maintain an activity log. It was reported that in all four cases the step activity monitor closely matched the recorded activity in the diaries.

MacRae, Schnelle, Simmons and Ouslander (1996) used time-sample observations and Caltrac motion sensors to describe activity levels of ambulatory nursing home residents. Physically restrained and unrestrained residents were categorized as inactive, only expending 5.9 kcal/hour and 4.4 kcal/hour, respectively. Both groups had fall risk being a significant predictor of physical activity. Petrella and Cress (2004) assessed daily ambulation with a DigiWalker Stepcounter on community-dwelling older adults categorizing them into high functioning and low functioning groups. The high functioning group took significantly more steps per day and reported modifying fewer tasks. It is unclear if physical decline is due to lower physical activity levels or if lower physical activity levels promote the decline in physical functioning.

Physical inactivity is an indicator of health status and is a major concern among older adults in the United States. There is a propensity to lose physical function and decrease the amount of daily physical activity performed as individuals' age. Of all the age categories, older adults are the least active group (King, Rejeski & Buchner, 1998). In 2002, more than one-half of older adults reported being physically inactive during leisure time (National Center for Health Statistics, 2004). In older adults, even some amounts of physical activity may improve cardiovascular function (Mensink, Ziese & Kok, 1999). Unfortunately, little has been done to assess the activity of older adults or what activity level needs to be achieved to maintain functional capacity.

The percentage of the older adult population is rapidly increasing. Currently, 12% of the population is 65 years of age or older. By 2020 individuals 65 years and older are expected to reach 16.3% of the population. In 2050, that percentage will increase to 20.7%, with 5.0% being 85 years of age and older (Administration on Aging, 2004) many of whom will need to be admitted into long-term care facilities.

This study was designed to determine the level of physical activity older adults in different levels of care. By measuring total steps taken by each participant per day the following research questions were examined: (1) Do independent living older adults take more steps per day than older adults residing in assisted-living facilities? (2) Do older adults residing in assisted-living facilities take more steps per day than older adults residing in nursing homes? (3) What is the relationship between steps per day and level of care? (4) What is the relationship between activities of daily, instrumental activities of daily living and steps per day in older adults living in long-term care facilities?

2. METHODOLOGY

Participants

Participants in this study consisted of 37 volunteers, both male and female over the age of 65. A continuing care retirement community with independent living (IL), assisted-living (AL) and nursing home (NH) facilities in Knoxville, Tennessee were used in this study. This facility houses 340 residents (96 IL, 44 AL, and 200 NH).

Prior to participant recruitment, a letter of cooperation was received from the vice president and administrator of the site stating the facility approved its residents serving as participants in the study. Meetings between the researcher and staff were conducted before recruitment to explain the study and eligibility requirements for the participants. Criteria for exclusion from the study included residents who had suffered a recent cardiovascular event (6 months prior), mental illness, severe dementia, and were non-ambulatory. Registered nurses, physical therapists, and activity directors for the three levels of care identified and helped recruit prospective participants. Recruitment meetings were organized to discuss the purpose and procedures of the study. At the recruitment event, a cover letter (Appendix E) and an informed consent (Appendix E) were provided to each prospective participant. Forms were read aloud and the participants asked questions about matters that were unclear. Consent forms were signed by the participants, returned to the investigator and a copy was given to each participant. The Institutional Review Board of The University of Tennessee approved the procedures.

Procedures

Data collection was completed over a 45-day period with physical activity recorded during weekdays. Activities of daily living (ADL) and instrumental activities of daily living (IADL) scales were administered by interview, reading each question to the participant and recording his/her responses on the survey sheets. During this interview information on age, height, weight, BMI, race, education, marital status, walking assistance used, perceived general health, income before assistance, current payment method (Medicare/Medicaid, private), diseases/disabilities, number of medications, level of care, time in level of care, residence before current level of care, reason for being admitted to current level of care was also collected. If participants were unable to provide this information it was collected from facility records. A day was agreed upon for wearing the StepWatch Step Activity Monitor3 (SW) for the entire day (from waking up until bedtime). The device was attached on the participant's right ankle by the researcher, the participant or a staff member the morning of the agreed upon date and was removed by the participant or facility staff before going to bed. Reminders and instructions were provided to the participants and staff on how to attach and remove the SW. Activity monitors were only removed for bathing and reattached immediately following by the participant or facility staff.

Instrumentation

StepWatch Step Activity Monitor3 (Cyma Incorporated, Seattle, WA) pedometers were used in this study. SW is a completely sealed microprocessor-controlled step counter. The instrument measures 75 x 50 x 20 mm in size, weighs approximately 37.01 grams and is made of high impact plastic that is contoured to fit comfortably against the leg. An elastic attachment strap ensures that the monitor remains securely attached to the ankle without irritating the skin. Programming and downloading are controlled with the StepWatch Analysis Software. This software is used to program a monitor prior to deployment and to download, view and analyze the data when the recording session is over. SW is programmed and downloaded to a host computer via its USB docking station. Each monitor's sensitivity is optimized for a participant's gait characteristics by the standard programming mode. Standard mode permits users to confidently program the SW by entering the participant's height and answering questions that describe the participant's gait. For this study the answers to these questions were standardized. Previous research using the SW concluded that it accurately measures steps taken by older adults in assisted-living facilities with a self-selected walking pace between 17.4 m $\cdot$ min^{-1} to 64.2 m $\cdot$ min^{-1} (Bergman, Bassett, Klein, in review).

ADL and IADL surveys were taken from the Older Americans Resources and Services Procedures (OARS) Multidimensional Functional Assessment Questionnaire (OMFAQ), copyright 1988, Center for the Study of Aging and Human Development, Duke University Medical Center, and used with permission (Fillenbaum, 1988) (Appendix E). On the ADL questionnaire participants were asked 8 questions pertaining to normal daily activities. Some of the questions asked were “Can you eat”, “Can you walk”, “Can you dress and undress yourself” and “Can you take a bath or shower”. Answers were scored 2 - without help; 1- with some help; 0 - completely unable to; or not answered. Seven questions concerning instruments used to perform daily tasks appear on the IADL questionnaire. These included “Can you use the telephone”, “Can you get to places out of walking distance”, “Can you do your housework”, and “Can you handle your own money”. Answers were scored 2 - without help; 1- with some help; 0 - completely unable to; or not answered**.** Scoring was computed using the ADL Rating Scale Equation (Fillenbaum, 1988).

OMFAQ is divided into two parts, Part A, Functional Assessment and Part B, Services Assessment. There are four areas that encompass Functional Assessment: Economic, Mental Health, Physical Health, and Self-Care Capacity. The surveys used examine the Self-Care component of Functional Assessment. All four areas have content and criterion validity (Fillenbaum & Smyer, 1981). Kendall's tau and Spearman's r_s for the Self-Care Capacity area are 0.83 and 0.89, respectively (Fillenbaum, 1988). Reliability coefficients for IADL and ADL are 0.87 and 0.84, respectively (Fillenbaum, 1988).

Statistical Analysis

All analyses were conducted using SPSS 13.0 for Windows (SPSS Inc., Chicago, IL). An alpha of 0.05 was used to indicate statistical significance for all analyses. One-way ANOVA was used to assess the difference between steps per day, ADL problems, ADL impairments, perceived health status, education level and income before assistance among the three different levels of care (IL, AL and NH). Tukey post-hoc analysis was used to determine where differences occurred between the different levels of care. Correlations were performed between ADL problems, ADL impairment and steps per day. Descriptive information on age, gender, height, weight, BMI, race, walking assistance, time in current level of care, residence before current level of care, reason for being admitted to current level of care, payment method, previous income, diseases/disabilities, and number medications were collected and used to further define the sample populations.

3. RESULTS

Selected results from the descriptive data analysis are presented in Table 1. Univariate ANOVAs indicate statistically significant differences between steps ($F_{2,34}$ = 4.65, p = .016), ADL problems ($F_{2,34}$ = 21.65, p < .001), ADL impairments ($F_{2,34}$ = 25.03, p < .001), perceived health status ($F_{2,34}$ = 6.96, p = .003), education level ($F_{2,34}$ = 6.51, p = .004) and income before assistance ($F_{2,34}$ = 3.39, p = .045) between the three levels of care (Table 2).

Tukey post-hoc tests revealed differences between the different levels of care. Steps differed significantly between the RH and AL (p = .017) (Figure 1). ADL problems, ADL impairments and walking assistance were different between RH and NH (p < .001, p < .001, p = .009, respectively); and between RH and AL (p = .001, p < .001, p = .002, respectively) (Figure 2). Perceived health status, number of medications and income before assistance diverged among RH and NH (p = .002, p = .048, p = .045, respectively). Education level was significantly different between RH and NH (p = .013); AL and NH (p = .008).

Spearman correlations (used with non-parametric data) (Table 3) indicate statistically significant negative relationships between level of care and steps (rho = -.404), perceived health status (rho = -.530), income before assistance (rho = -.360) and education level (rho = -.364). Significant positive correlations were found for ADL problems (rho = .730), ADL impairments (rho = .747) and number of medications taken (rho = .422). The number of steps taken had a significant negative relationship with ADL problems (rho = -.587), ADL impairment (rho = -.621) and perceived health status (rho = -.346). ADL problems positively correlated with ADL impairments (rho = .992) and

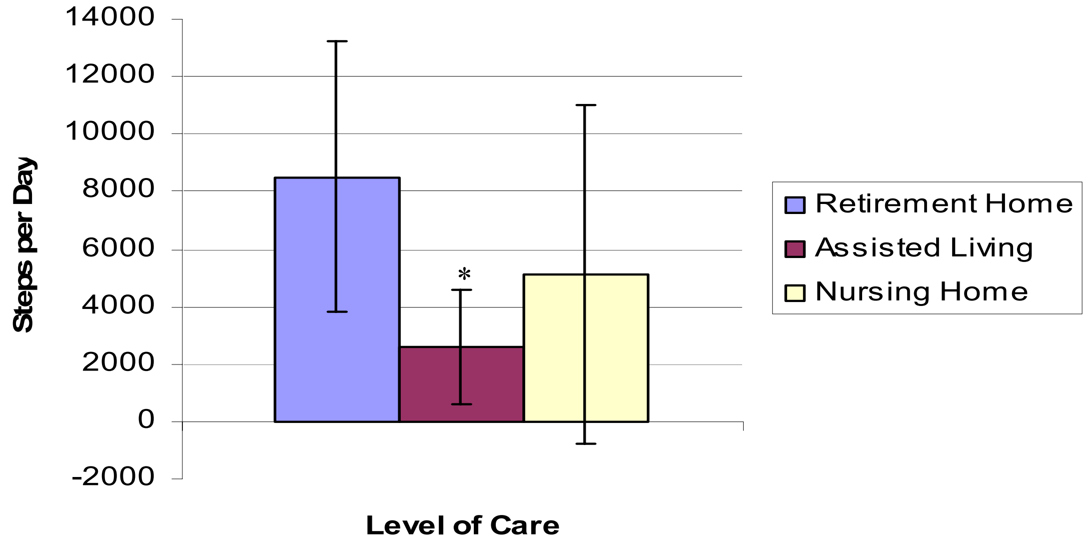
Table 1. Characteristics of Participants (means ± standard deviation)

	NH (N = 12)	AL (N = 8)	RH (N = 17)	All (N = 37)
Age (yrs)	85.53 ± 3.16	87.00 ± 4.04	85.42 ± 5.50	85.81 ± 4.16
Gender (males/females)	3/9	3/5	5/12	11/26
Height (cm)	166.14 ± 9.68	163.53 ± 5.92	162.13 ± 9.98	164.29 ± 8.96
Weight (kg)	64.9 ± 11.3	66.0 ± 13.3	61.5 ± 13.8	64.1 ± 12.4
Race (% Caucasian)	100%	100%	100%	100%
BMI	24.22 ± 4.55	24.56 ± 4.29	23.36 ± 2.52	23.90 ± 3.61
Time in level of care (months)	45.94 ± 28.53	17.50 ± 12.24	11.42 ± 13.07	28.59 ± 26.66
Currently married	25%	0%	47.06%	29.73%
Walking Assist	58.33%	100%	11.76%	45.94%

Table 2. Univariate ANOVAs and Tukey Post-Hoc (means ± standard deviation)

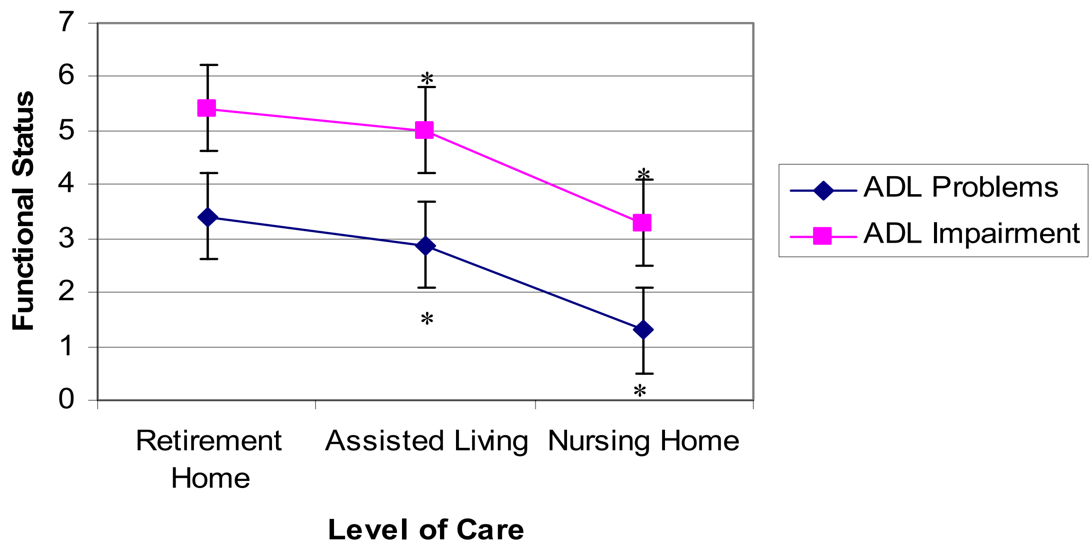
	NH (N = 12)	AL (N = 8)	RH (N = 17)	All (N = 37)
Steps	5117.17 ± 5913.01^{ab}	2592.75 ± 1961.69^{a}	8518.47 ± 4707.78^{b}	6134.11 ± 5205.60 *
ADL problems	$1.29 \pm .99^{c}$	$2.88 \pm .99^{c}$	$3.42 \pm .67^{d}$	2.32 ± .1.31 *
ADL impairments	$3.29 \pm .99^{e}$	$5.00 \pm .77^{e}$	$5.42 \pm .67^{f}$	4.35 ± 1.30 *
Perceived health	$2.00 \pm .74^{g}$	$2.38 \pm .74^{gh}$	$3.00 \pm .71^{h}$	2.54 ± .84 *
Education level	$1.75 \pm .87^{i}$	$2.75 \pm .46^{jk}$	$2.53 \pm .62^{k}$	2.32 ± .78 *
Income before assistance	$1.50 \pm .52^{l}$	$2.00 \pm .00^{lm}$	$2.06 \pm .75^{m}$	1.86 ± .63 *
Number of medications	9.33 ± 2.77^{n}	7.88 ± 6.40^{no}	5.53 ± 3.50^{o}	7.27 ± 4.33 *

Pairs not sharing a common superscript are significantly different at the p ≤ .05 level by Tukey post-hoc analysis.
* indicates significance among the levels of care at the p ≤ .05.



* p ≤ .05 between RH and AL

Figure 1. Steps per Day vs. Level of Care



* p ≤ .05 between RH and AL and between RH and NH

Figure 2. Functional Status vs. Level of Care

Table 3. Spearman Correlations

		Steps	ADLP	ADLI	Health	Income	Education	Number
Level	Coefficient	-.404*	.730*	.747*	-.530*	-.360*	-.364*	.422*
	Sig.	.013	.000	.000	.001	.028	.027	.009
Steps	Coefficient	1.00	-.587*	-.621*	-.346*	.108	-.018	-.076
	Sig.		.000	.000	.036	.523	.916	.655
ADLP	Coefficient	-.587*	1.00	.992*	-.616*	-.166	-.256	.426*
	Sig.	.000		.000	.000	.326	.127	.009
ADLI	Coefficient	- .621*	.992*	1.00	-.610*	-.166	-.240	.406*
	Sig.	.000	.000		.000	.326	.153	.013
Health	Coefficient	-.346*	-.616*	-.610*	1.00	.176	.211	-.481*
	Sig.	.000	.000	.000		.297	.211	.003
Income	Coefficient	.108	-.166	-.166	.176	1.00	.362*	-.031
	Sig.	.523	.326	.326	.297		.028	.853
Education	Coefficient	-.018	-.256	-.240	.211	.362*	1.00	.088
	Sig.	.916	.127	.153	.211	.028		.603
Number	Coefficient	-.076	.426*	.406*	-.481*	-.031	.088	1.00
	Sig.	.655	.009	.013	.003	.853	.603	

* indicates significance at $p \leq .05$

number of medications (rho = .426) and negatively with perceived health (rho = -.616). ADL impairments also negatively correlated with perceived health (rho = -.610) and positively with number of medications (rho = .406). Perceived health status negatively correlated with number of medications (rho = -.481) and income before assistance was positively correlated with education level (rho = .362).

Coding affects the direction of the correlations. Functional status is referred to in terms of ADL problems and impairments. As functional status decreases, problems and impairments increase, causing the negative correlation with steps and perceived health. Some of the data was coded as follows:

Level of Care: 1 – Retirement Home 2- Assisted-living 3- Nursing Home

Education: 1 - Not graduate from high school 2 - Graduated from high school 3 - Graduated from college

Perceived Health Status: 1 – Poor 2 – Fair 3- Good 4 – Excellent

ADL problems: 0 – No 1 – Mild 2 – Moderate 3 – Severe 4 - Total

ADL impairment: 2 – Excellent/Good 3 – Mild 4 – Moderate 5 – Severe

Residents in the retirement home took significantly more steps on the day of data collection than residents in the assisted-living facility but were not more active than residents of the nursing home. ADL problems and impairments differed between all the levels except AL and NH. Correlations showed that as a resident requires more skilled care the number of steps and perceived health decreases. As the number of steps taken decrease, ADL problems and ADL impairments increase.

4. DISCUSSION AND CONCLUSIONS

Scientific evidence indicates that regular physical activity can bring dramatic health benefits to people of all ages and abilities. These benefits will extend over the entire lifetime if physical activity levels are maintained. Physical activity offers the opportunity for people to extend years of active independent life and reduce functional limitations. One of the most effective ways older adults can prevent chronic diseases, promote independence and increase quality of life is through regular participation in physical activity.

It was no surprise that adults in the retirement home walked more and reported a higher level of functional status than older adults in the two other levels of care. Petrella and Cress (2004) found similar results in community dwelling older adults categorized into high and low functioning groups. The high functioning group took more steps per day and did not report modifying as many tasks as the low functioning group. As individuals reduce ambulation activity they increase their risk of becoming dependent (Guralnik, Gerrucci, Simonsick, Salive & Wallace, 1995). Cress and Meyer (2003) determined threshold values for VO_{2max} ($20\ mL \cdot kg^{-1} \cdot min^{-1}$) and isokinetic knee extensor torque ($2.5\ N \cdot m/[kg^{\cdot m-1}]$ accurately predicted individuals reporting functional limitations on the Continuous-Scale Physical Functional Performance Test (CS-PFP). They mention that a physical reserve (maximal voluntary performance in excess of that needed to perform daily functions) may be present due to a delay in the loss of function relative to the loss of maximal voluntary performance (Cress & Meyer, 2003). Mobility can be limited due to physical inactivity which is associated with poor muscle force production leading to further reductions in physical activity (Rantanen, Guralnik, Sakari-Rantala, Leveille, Simonsick, et al., 1999). This downward trend jeopardizes the independence of the individual.

Lower functioning older adults modify their mobility-related tasks. In the early stages of physical decline, individuals use modification strategies to compensate for declines in physical capacity in order to accomplish daily tasks (Williamson & Fried, 1996). Examples of these modifications are eating fewer meals, using only a portion of the residence and bathing only a few times per week. In long-term care facilities, where multiple supportive services are provided and professional assistance is easily obtained residents lack the physical challenges of independent living. This less demanding environment can lend itself to the downward spiral effect of losing physical function.

The finding that residents in the nursing home took more steps than older adults residing in the assisted-living facility was contrary to what was hypothesized. MacRae, Schnelle, Simmons and Ouslander (1996) found very low activity levels in physically restrained and unrestrained nursing home residents. Time-sampled observations and Caltrac motion sensor revealed both groups were inactive. Restrained residents spent 93.8% and unrestrained residents 83.5% of their observed time either lying down or sitting. The Caltrac motion sensor calculated an average of 34 kcal/day and 47 kcal/day per day above resting metabolic rate were expended by restrained and unrestrained residents, respectively (MacRae, et al., 1996).

An explanation for the reported differences in steps per day between AL and NH residents could be due to what is known as “sundowning”. Sundowning is a phenomenon of increasing agitation that occurs near sunset or evening hours and is often observed in patients with dementia, but it is not a psychiatric diagnosis (Burney-Puckett, 1996)

(Figure 3). Figure 3 demonstrates the activity sundowning behavior of a resident. Notice the activity throughout the day is minimal to none, then around seven o'clock activity levels increase in frequency and intensity and continues until eleven o'clock. Various behaviors that are specific to this syndrome include wandering, hyperactivity, confusion and aggressive behavior (Burney-Puckett, 1996). Bliwise (1994) cites three hypotheses for this behavior: sleep apnea, rapid eye movement sleep disorder and deterioration of the superchiasmatic nucleus. The superchiasmatic nucleus is responsible for maintaining circadian rhythms; with its decline the sleep-wake cycle is disrupted.

Wandering behavior associated with sundowning is a risk factor for falling and wandering away (elopement) (Kiely, Kiel, Burrowns, Lipsitz, 1998; Algase, Beel-Bates & Beattie, 2003). A general description of wandering is locomotion that is non-direct and is comprised of three patterns: random, lapping and pacing (Algase, Bettie & Therrien, 2001). It is a multi-faceted behavior that has different levels of risk. Kiely, Morris and Algase (2000) identified ten characteristics associated with the development of wandering. Five categories encompass these characteristics: cognitive impairment, discomfort or unsettled states, medication used, clinical factors and ability to wander (Kiely, Morris & Algase, 2000). Professional caregivers need to be aware of the characteristics and categories so they can understand and respond to this behavior. Cohen-Mansfield, Werner, Culpepper, Wolfson and Bickel (1997) evaluated four devices (Mini-Motionlogger Actigraph, Personal Activity Meter (PAM), Step Sensor and the Heartline pedometer) as measures of pacing behaviors and compared the number of steps taken to behavioral observations. They concluded that these devices offer an objective

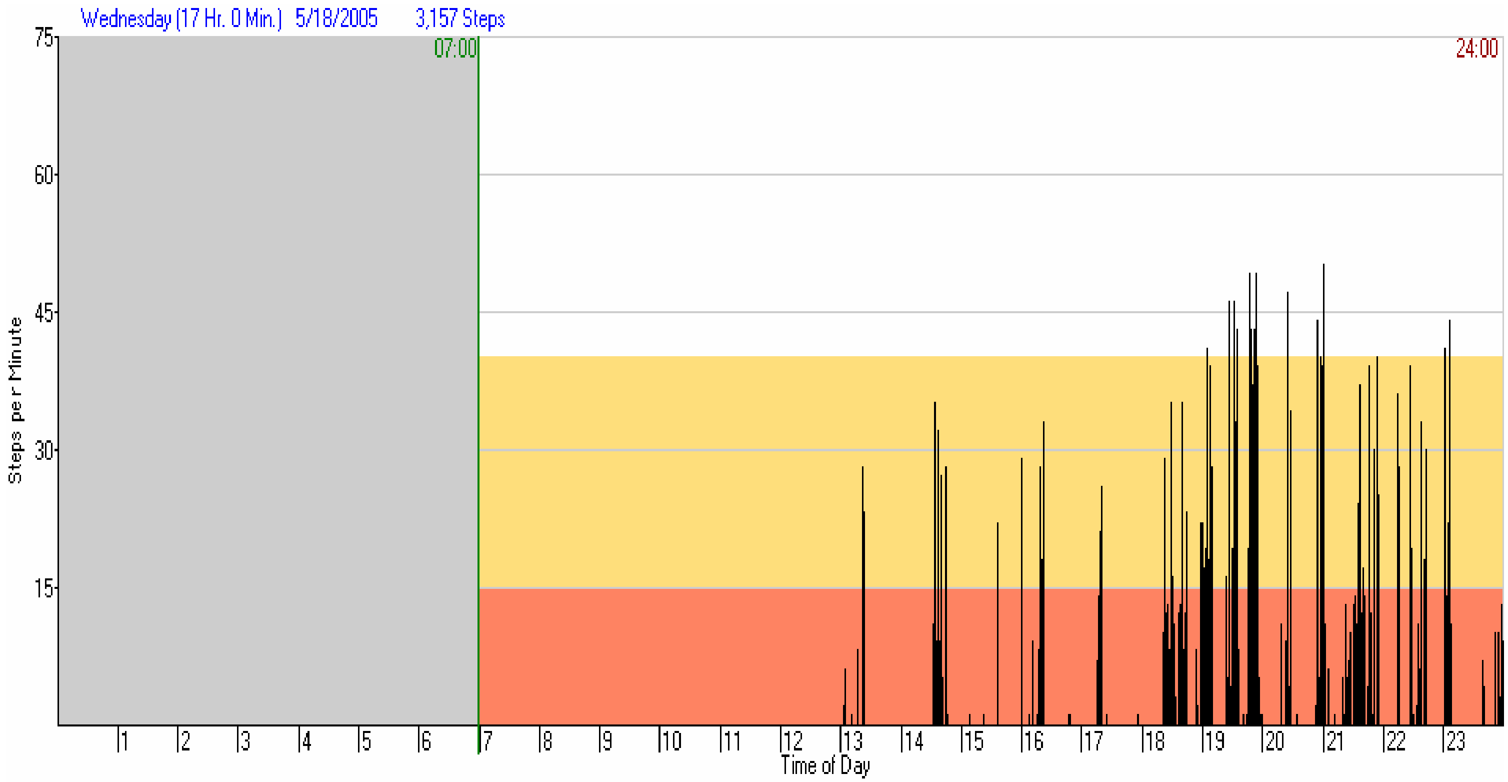


Figure 3. Example of Sundowning Behavior. This figure demonstrates the sundowning behavior in steps per minute across one full day of data collection. No activity takes place until one o'clock, then at seven o'clock activity increases in frequency and intensity. This high level of activity continuous into the late evening finally subsiding at eleven o'clock.

measure of the wandering behavior (Cohen-Mansfield, et al., 1997).

There are a couple of observed explanations that might help further explain this difference. First, the assisted-living facility did not have a conducive layout to promote walking. The hallways were set-up in an L-shape, where the residents would have to make a number of turns in order to walk around the hallways, thus increasing the chance for falls. In the nursing home the hallways were in a rectangular shape where only four turns were needed to complete a lap. Second, physical therapy was conducted regularly in the nursing home. Residents in the assisted-living mostly took part in therapy to aid in injury recovery a couple times per week. Therapists in the nursing home constantly had patients walking with assistance at least twice per week to keep them active. Since the assisted-living residents are considered to be more independent, walking was to be done on their own time and was not a part of therapy.

Functional decline of the participants were expected at the different levels of care. Although, the functional status of nursing home residents in this study was not related to physical activity, other studies have demonstrated this relationship. Activity level and walking speed were determinants of independence in older adults (Cunningham, Paterson, Himann & Rechnitzer, 1993). In a fourteen-year prospective study, results suggest that physical activity plays a role in maintaining functional ability as individuals age (Brach, FitzGerald, Newman, Kelsey, Kuller, et al., 2003). Unger, Johnson and Marks (1997) determined that physical activity applied an independent effect on functional decline over a six-year period. Because the ability to function independently is an important determinant in the health status of older adults, programs are needed to encourage physical activity early in life so that independence can be maintained in later life.

Limitations

This study was limited by the disproportionate number of females to males. When conducting research with older adults this limitation is common, because females have longer life expectancies than males. The sampling procedure is another limitation of this study. Retirement home, assisted-living and nursing home participants were self-selected and not randomly selected. There is a chance that the residents that live in these levels of care are not typical of the general population. Other limitations can be identified. Data was only collected on individuals who were Caucasian. Limited cultural diversity was present in the facility used in this study. Participants had to be ambulatory, cognitively capable and not suffered from a heart attack or stroke in the last six months. The sample size was small, especially in the nursing home and assisted-living groups. Total step counts were completed for only one day of activity. It was difficult to get older adults in assisted-living and nursing homes to participate in research over a long period of time. A limited number of StepWatches were available due to cost, $500 each, and time only allowed for one day of data collection. These limitations do not allow the results to be generalized to all long-term care residents. More research is needed to address these limitations and physical activity levels in these residents.

Summary and Conclusions

Residents in the retirement home took significantly more steps than residents in the assisted-living facility but were not more active than residents of the nursing home. ADL problems and impairments differed between all the levels except AL and NH.

Correlations showed that as a resident requires more skilled care the number of steps and perceived health decreases.

Major conclusions from this investigation were: 1) Adults living in a retirement community take more steps per day than older adults residing in assisted-living facilities. 2) Older adults residing in assisted-living facilities do not take more steps per day than older adults residing in nursing homes. 3) There is a negative relationship between steps per day and level of care in older adults living in long-term care. 4) There is a negative relationship between steps per day and functional status in older adults living in various levels of care. As older adults progress through the stages of long-term care, retirement home to assisted-living to nursing home, the number of steps per day and functional status decreases, as a whole. In this study population residents in the nursing home took more steps on the day of data collection then those residing in assisted-living.

StepWatch Step Activity Monitor3 was tolerated by all participants with the majority mentioning that they forgot they were wearing the device until changing to get ready for bed. This device showed that it can be used in populations with a wide variety of gait pattern, slight cognitive impairment and as an objective monitoring device to document the physical activity of long-term care residents.

With life expectancy increasing, it is important to reduce the decline of functional status that comes with age. Motivating individuals to maintain recommended levels of physical activity over a lifetime would help sustain the functional status needed for independent living during old age. Physical activity offers a great opportunity to extend years of independent life and reduce morbidity and disability in older adults. The functional decline of older adults is a major public health issue that needs to be extensively researched and addressed before it is too late. Adequate amounts of physical activity may increase quality of life and decrease functional status deficits. Identifying declines in daily ambulation and function will provide guidance for appropriate interventions or may enable transition to a different level of care for older adults residing in long-term care facilities.

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APPENDIXES

APPENDIX A

REVIEW OF THE LITERATURE

Background and Introduction

Physical activity epidemiology has emerged as a new field of study over the past twenty years. However, the ideas that underlie the field are not new but are dated to the use of structured exercise for health in China around 2500 B.C. (Lyons & Petrucelli, 1978). Dr. Allen Ryan (1984) wrote one of the first modern accounts of the history of physical activity and health by concluding that "the concept of health is older than knowledge about the causes of disease." Ancient Indian medicine, ninth century B.C., recommended exercise and massage for the treatment of rheumatism (Guthrie, 1945). Greek physician Herodicus specialized in therapeutic gymnastics around 480 B.C. and Asclepiades recommended walking and running for his patients during the first century B.C. (Vallance, 1995). Aristotle (1908) stated "bodily health is a result of the fondness for gymnastics; a man falls into ill health as a result of not caring for exercise."

Scholars in Italy recommended gymnastics as a fundamental part of education during the Renaissance (Struever, 1993). Italian physician Mercurialis urged all people who led sedentary lives to exercise and replaced passive exercises with vigorous exercises involving healthful breathing and physical effort for health purposes (Dishman, Washburn & Heath, 2004). In the mid 1400s, Leon Battista Alberti recommended physical exercises begin in infancy and became more important with increasing age (Dishman, et al., 2004). The role of physical fitness in preventative medicine was further advocated by Edward Hitchcock, Jr., Dudley Sargent and R. Tait McKenzie during the 1870s until the early 1900s (Dishman, et al., 2004).

Modern physical activity epidemiology has a short history, beginning in the 1940s with Dr. Jeremy Morris of the London School of Hygiene and Tropical Medicine of the University of London. He and his co-workers established the methods for collection, analysis and interpretation of data on the causes of chronic diseases (Paffenbarger, Blair & Lee, 2001). A growth in the field took place in the 1980s and has continued up to the present time (Paffenbarger, et al., 2001). Landmark research was conducted by Dr. Morris and colleagues in the 1950s on the association of physical activity and the reduction of chronic diseases, mainly coronary heart disease (CHD). The first study found that highly active conductors on double-decker buses were at lower risk of CHD than drivers who sat the majority of their shifts at the steering wheel (Morris, Heady, Raffle, Roberts & Parks, 1953). Many studies concerning occupational and leisure-time activity effects on chronic diseases occurred after this landmark study was published. Ralph Paffenbarger initiated the San Francisco Longshoremen Study and the ongoing College Health Study in the 1960s and 70s (Paffenbarger, Lauglin, Gima & Black, 1970; Paffenbarger, Wing & Hyde, 1978). These studies have fueled scientific and public interest in physical activity as an important component of health and preventative medicine.

Aging is often viewed as a time of inactivity and disease. It is these misperceptions that continue to foster ageism, the negative view of aging, in our society. Currently, 12% of the population is 65 years of age or older. By 2020 individuals 65 years and older are expected to reach 16.3% of the population. In 2050, that percentage will increase to 20.7%, with 5.0% 85 years of age and older (Administration on Aging, 2004). This shift in age demographics is the result of 77.7 million baby boomers (individuals born between the years 1946 – 1964) moving into the older adult age category (MetLife, 2003). In 2002 it is reported that 65% of adults in the United States were overweight, 31% obese and 40% do not engage in leisure time physical activity (National Center for Health Statistics, 2004). During the same year more than one-half of older adults indicated being physically inactive during leisure time (National Center for Health Statistics, 2004). Of all the age categories, older adults are the least active group (King, Rejeski & Buchner, 1988). In older adults, even some amounts of physical activity may improve cardiovascular function (Mensink, Ziese & Kok, 1999). Unfortunately, little has been done to assess the activity of older adults or what activity level needs to be achieved to maintain functional capacity.

Physical activity is defined as “any bodily movement produced by skeletal muscle that results in energy expenditure” (Caspersen, Powell & Christenson, 1985). This includes occupational work, leisure activity and exercise. As individuals’ age their physical activity levels decline. With the decline in activity their energy expenditure and level of function is reduced. Loss of function contributes to disability usually geometrically; the loss is proportionally greatest in the later years of life (Dishman, et al., 2004). Successful aging is dependent on maintaining physical activity and functional status. The loss of muscle strength, decreased flexibility, range of motion and sense of balance that frequently accompanies aging contribute to functional decline (Burbank, Reibe, Padula & Nigg, 2002).

Functional disability refers to limitations in performing independent living tasks, which are often further divided into activities of daily living (ADLs) and instrumental activities of daily living (IADLs) (Lawton & Brody, 1969; Verbrugge & Jette, 1994). As individuals age, the accompanying deterioration in function and the restriction in performance of ADLs and IADLs serve to reduce older adults' sense of control (Mazzeo, Cavanagh, Evans, Fiatarone, Hagberg, & McAuley, 1999). ADLs are activities that represent one's ability to manage bodily care. These activities include: eating, dressing, bathing, toileting, transferring from standing to a bed or a chair, grooming, climbing stairs, and bladder control. IADLs reflect an individual's ability to maintain a safe, clean household and include meal preparation, shopping, taking medications, managing money, telephoning, chores, light housework, transportation, and laundry. More than half of the older adult population (54.5%) report having at least one physical or non-physical disability. Over 4.5 million (14.2%) have difficulty carrying out ADLs and 6.9 million (21.6%) report difficulties with IADLs (Administration on Aging, 2002). Research has shown that participation in a regular physical activity program is an effective intervention to reduce/prevent functional declines associated with aging (Mazzeo, et al., 1999). Physical activity programs, (including aerobics, strength training, flexibility, and balance exercises,) can improve health, functional capacity, quality of life and independence for older adults (Mazzeo, et al., 1999).

Literature Review

Since the purpose of this study was to determine the level of physical activity for older adults in different levels of care by measuring total steps taken per day, many different areas of the research literature have been reviewed. These areas include the benefits of physical activity for older adults, measuring functional status in older adults, methods for measuring physical activity, measuring physical activity in older adults and measuring physical activity in long-term care facilities. All the tools, techniques and instruments used in this study have been validated in previous studies and were selected for ease of administration.

Benefits of Physical Activity for Older Adults

Research shows that physical activities typical of everyday life have favorable associations with several major cardiovascular disease risk factors among community-dwelling older adults (Pescatello & Dipietro, 1996; Pescatello & Murphy, 1998; Pescatello, Murphy & Costanzo, 2000). Older individuals who reported greater amounts of activity throughout a day had improved glucose levels, blood lipid profiles and abdominal fat distribution compared to older adults who get less activity (Pescatello, Murphy, Anderson, Costanzo, Dulipsingh & De Souza, 2002). Regular participation in physical activity is associated with numerous health benefits (Pate, Pratt, Blair, Haskell, Macera, Bouchard, et al., 1995; U.S. Department of Health and Human Services, 1996) that include reduced mortality and morbidity from cardiovascular disease, diabetes and certain cancers in middle-aged (Paffenbarger, Hyde, Wing & Hsieh, 1986; Leon, Connett, Jacobs & Rauramaa, 1987; Lee, Hsieh & Paffenbarger, 1995) and older adult populations (Kushi, Fee, Folsom, Mink, Anderson & Sellers, 1997; Morgan & Clarke, 1997; Bijnen, Caspersen, Feskens, Saris, Mosterd & Kromhout, 1998).

There is evidence that older people benefit from physical activity (Kaplan, Seeman, Cohen, Knudsen & Guralnik, 1987; Sherman, D'Agostina, Cobb & Kannel, 1994). Increased physical activity or improved fitness even in later life improves mortality outcomes (Paffenbarger, Hyde, Wing, Lee, Jung & Kampert, 1993; Blair, 1995). Wannamethee, Shaper and Walker (1998) conducted a prospective study on 4311 older men with no history of cardiovascular problems. Follow-up data was collected 12-

14 years after baseline and then again 4 years later. They concluded that maintaining or taking up light or moderate physical activity reduces heart attacks and mortality in older men (Wannamethee, et al., 1998).

In 1990, 52% of American men and 44% of American women aged 65 and older reported walking for exercise in the last two weeks (Piani & Schoenborn, 1993). A four year prospective study was conducted to determine if walking is associated with a reduced risk of cardiovascular disease hospitalization and death in community-dwelling older adults (LaCroix, Leveille, Hecht, Grothaus & Wagner, 1996). A modified version of the Minnesota Leisure Time Activity Questionnaire (Taylor, Jacobs & Schucker, 1978) assessed physical activity. The authors concluded that walking more than four hours per week may reduce the risk of hospitalization for cardiovascular disease events and reduced the risk of death by mediating other risk factors (LaCroix, et al., 1996).

Rakowksi and Mor (1992) reported on self-reported physical activity and mortality among adults aged 70 and over using data from the Longitudinal Study on Aging. Results indicated that less activity was associated with higher risk of mortality. Walking was associated with lower mortality rates in individuals with one or more IADL impairments (Rakowksi & Mor, 1992). A prospective cohort study conducted at four locations throughout the U.S. assessed women aged 65 years or older on their physical activity levels using the Harvard Alumni Questionnaire (Gregg, Cauley, Stone, Thompson, Bauer, et al., 2003). Reassessment took place six years after baseline data was collected. This studied concluded that increasing or maintaining physical activity levels could lengthen life for older women (Gregg, et al., 2003).

Twenty-nine community-dwelling women aged 66 – 82 years reported habitual physical activity on the Questionnaire d'Activite Physique Saint-Etienne (QAPSE) (Berthouze, Minaire, Chatard, Boutet, Castells & Lacour, 1993) and performed maximal aerobic and anaerobic tests. Habitual physical activity was found to contribute to the variance of the maximal anaerobic power of the quadriceps muscle (Kostka, Bonnefoy, Arsac, Berthouze, Belli & Lacour, 1997). Preserving quadriceps function is important for basic ADLs like walking and rising from a chair. With lower extremity function declining more rapidly than in the upper limbs (Aoyagi & Shepard, 1992), quadriceps power may be considered to be the most important determine of functional independence in older adults.

Women aged 70 to 81 years in the Nurses' Health Study showed long-term physical activity, including walking, is associated with better cognitive function and less cognitive decline. Differences in cognition observed between women with higher versus lower levels of activity were similar in magnitude to the differences in cognition found among women two to three years apart in age (Weuve, Hee Kang, Manson, Breteler, et al., 2004). A significant relationship was shown in a cohort of two-hundred twenty-nine older women between physical activity over a fourteen year period and current functional status. These women were randomized in a controlled walking intervention with physical activity being assessed at three different points by questionnaires and physical activity monitors. Functional status was assessed at the end of the fourteen year period. These finding suggested that long term physical activity plays a role in maintaining functional status later in life (Brach, FitzGerald, Newman, Kelsey, Kuller, et al., 2003).

Physical activity offers one of the greatest opportunities for people to extend years of independent life and reduce functional decline. Health benefits of regular physical activity include improved myocardial performance, heart-muscle contractility, perceived well-being, strength, flexibility, physical functional performances, increased muscle mass, total energy expenditure and decreased bone-mineral density loss (Cress, Petrella, Moore & Schenkman, 2005; Singh**,** 2000). Older adults who participate in regular physical activity reduce the risks for developing chronic diseases, promote independence and add quality of life years.

Measuring Functional Status in Older Adults

As individuals age the accompanying deterioration in function and the restriction in performance of ADLs serve to reduce the individual's sense of control. Physical performance measures provide insight into the ability of older adults to perform specific tasks that are important for daily living. Many performance-based measures such as the Function Reach Test (Duncan, Weiner, Chandler & Studenski, 1990) and the Six-minute walk test (Butland, Pang, Gross, Woodcock & Geddes, 1982) only assess a single task. Some measures may not adequately challenge older individuals with higher levels of functioning (Cress, et al., 2005). The Continuous-Scale Physical Functional Performance Test (CS-PFP) consists of sixteen household tasks that are performed as a measure of usual function (Cress, Buchner, Questad, Esselman, deLateur & Schwartz, 1996). Measurements from the CS-PFP are reliable, valid and sensitive to change (Cress, et al., 1996). A shorter version of the CS-PFP was developed, Physical Functional Performance 10 (PFP-10) Test, that requires less space, time and can be used in a community setting

(Cress, et al., 2005). Cress, et al (2005) stated that the PFP-10 produces valid, reliable and sensitive measurements and can be substituted for the CS-PFP.

In a recent study community-dwelling older adults were classified into two groups (High and Low functioning) based upon their scores on the CS-PFP. Daily ambulation was assessed with a DigiWalker Stepcounter over a seven-day period. Self-reported functional declines were determined by a modified version of the Supplement on Aging National Health Interview Survey (Fitti & Kovar, 1987) and assessed by task difficulty and task modification (Petrella & Cress, 2004). Results showed that participants in the High functioning group took significantly more steps per day and reported modifying fewer tasks than the Low functioning group (Petrella & Cress, 2004).

Plehn, Marcopulos and McClain (2004) used the Self-Evaluation of Life Function (SELF) Scale (Linn & Linn, 1984) to look at how performance on neuropsychological measures is related to self-reported functional status in rural living older adults. The SELF scale is a fifty-four item self-report instrument used to measure both ADLs and IADLs in independent living in community-dwelling older adults. In 133 rural community-dwelling older adults neuropsychological tests predicted self-reported IADL and social functioning (Plehn, et al., 2004).

Seventy-five men and women, aged 65 – 85, completed questionnaires which documented health status, exercise patterns, levels of physical capacity, independence in daily living and involvement in activities (Fone & Lundgren-Lindquist, 2003). These questionnaires were the Modified Health Status of Older Persons (Kendig, Helme, Teshuva, Osborne, Flicker & Browning, 1996), Modified Functional Capacity Questionnaire (Lundgren-Lindquist, 1982) and the Physical Activity Scale for the Elderly

(PASE) (Washburn, Smith, Jette & Janney, 1993). Information obtained showed that this group was involved in a wide range of activities, rarely used community services and maintained a fairly high level of physical activity. No significant differences were shown by the Functional Capacity Questionnaire in personal ADLs or IADLs. This may suggest that this group is ageing successfully and retaining their independence (Fone & Lundgren-Lindquist, 2003)

Veterans Health Administration residents in community nursing facilities were compared with other residents throughout the United States. Minimal Data Sets were completed within days of admission and document the presence of disease or infection that have a relationship with each resident's ADLs, cognitive status, medical treatments, mood, behavior or risk of death (Morris, Murphy & Nonemaker, 1995). The ADL long scale developed by Morris, Fries and Morris (1999) was used in this study and is comprised of seven items: dressing, personal hygiene, transfer, locomotion, toilet use, eating, and bed mobility. Male Veterans Health Administration residents were found to be significantly more independent in ADLs and less physically disabled than other male nursing home residents (Buchanan, Johnson, Wang, Cowper, Kim & Reker, 2004).

Using self-reported ADL and IADL functioning in older adults may be as beneficial a research tool as functional performance measures (Myers, Holliday, Harvey & Hutchinson, 1993; Whittle & Goldenberg, 1996). Even though cognitive impairments and potential guessing in the older adult population are issues of concern for self-reported questionnaires (Guralnik, Branch, Cummings & Curb, 1989), research as demonstrated that older adults can accurately appraise their physical functioning (Alexander, Guire, Thelen, Ashton-Miller, Schultz, et al., 2000).

Methods for Measuring Physical Activity

Several methods are available for measuring physical activity including self-report questionnaires, behavioral observation and motion sensors. The problem is that there is no acceptable criterion measure with which to compare physical activity results. Behavioral observation provides a criterion but it is impractical to implement constant surveillance of individuals. All current methods of measuring physical activity have a certain amount of error, some more than others, that is understood and researchers are trying to minimize.

Self-reported physical activity questionnaires or interviews are the most frequently used methods. Numerous questionnaires have been used to collect physical activity data in many different populations. In epidemiological research the Harvard Alumni Physical Activity Survey and the Stanford Seven-Day Physical Activity Recall Interview (PAR) are commonly used (Dishman, et al., 2004). The Harvard Alumni Physical Activity Survey is brief and contains questions about walking, stair climbing and recreational activity over the past week or several years. Reduced risk for chronic disease in the Harvard alumni population has been assessed with this survey (Lee & Paffenbarger, 2000; Sesso, Paffenbarger & Lee, 2000). The Stanford Seven-Day Physical Activity Recall Interview is an interviewer-administered survey that requests information on sleep, aerobic activity, work-related activity, gardening, walking and leisure-time activity of moderate intensity or greater over the past seven days (Sallis, Haskell, Wood, Fortmann, Rogers, et al., 1985).

Before activity can be increased in a population, prevalence rates and trends within the population and its subgroups must be established. In the United States, trends are estimated by using the Behavioral Risk Factor Surveillance System (BRFSS). This system is a population-based telephone survey that has provided data on physical activity, obesity, and fruit/vegetable intake (Remington, Smith, Williamson, Anda, Gentry & Hogelin, 1988). Brownson, Jones, Pratt, Blanton and Heath (2000) stated that the 2000 version of the BRFSS did an adequate job of assessing leisure time physical activity but not a wide range of moderate intensity activities. A new set of BRFSS physical activity questions has been developed to measure moderate intensity activity (Brownson, et al., 2000).

Accelerometers are motion sensors that measure bodily movement or acceleration by evaluating movement in one or three directions. Designed to be worn on a belt at the waist, they provide data on both intensity and frequency of movement (Dishman, et al., 2004). Commonly used accelerometers are the Caltrac Personal Activity Computer, TriTrac and Computer Science Applications (CSA). When used in older adults the Caltrac has not demonstrated sufficient evidence of reliability and validity (Miller, Freedson & Kline, 1994). There is evidence of reliability and validity of the TriTrac when used in the older adults population (Kochersberger, McConnell, Kuchibhatla & Pieper, 1996), but the participants reported that the device was not comfortable or practical (Kochersberger, et al., 1996). Only moderate associations between the CSA's steps per minute and energy expenditure measures during treadmill and over-ground walking and running have been reported (Melanson & Freedson, 1995). Concerns about the accuracy of accelerometers for use in the older adult population exist. Especially since most of the validity testing has been conducted with children and young adults. Altered gait patterns could cause the accelerometers to be less accurate at estimating activity and energy expenditure (Jakicic, Winters, Lagally, Ho, Robertson & Wing, 1999; Matthews, Freedson, Herbert, Stanek, Merriam & Ockene, 2000).

Pedometers are devices worn at the waist to count steps by measuring vertical movement, and limited to providing total counts of vertical activity including walking, jumping, kneeling and bending. They vary in their degree of accuracy and have instrument errors ranging from 1.3% to 15% due to their dependence on vertical movement (Bassett, Ainsworth, Leggett, Mathien, Main, et al., 1996). Welk, Differding, Thompson, Blair, Dziura and Hart (2000) reported a low correlation ($r = 0.34$) between the Yamax Digi-Walker pedometer's average step count over a weeks time and the Stanford Seven-Day Physical Activity Recall Interview. Bassett, Cureton and Ainsworth (2000) found similar correlations between the College Alumnus questionnaire (CAQ) and the Yamax Digi-Walker in men ($r = 0.346$) and a higher correlation in women ($r = 0.481$) who wore the pedometer for seven consecutive days. When the Yamax Digi-Walker was compared to the CSA accelerometer, a strong linear relationship between physical activity outputs was found (Tudor-Locke, Ainsworth, Thompson & Matthews, 2002). Schneider, Crouter, Lukajic and Bassett (2003) stated that the Yamax Digi-Walker SW-701 pedometer displayed values within ± 3% of actual steps over a 400 meter walk. Crouter, Schneider, Karabulut and Bassett (2003) concluded that pedometer accuracy for step counting increases at higher walking speeds. At slower walking speeds commercially available spring-levered pedometers demonstrated significantly lower step counts when compared to visually counted steps (Melanson, Knoll, Bell, Donahoo, Hill, et al., 2004). Because older individuals tend to ambulate at slower walking speeds it was recommended that a more sensitive device be used to monitor activity (Melanson, et al., 2004).

The step activity monitor is a new type of motion sensor that is worn at the ankle. This device does not estimate metabolic demands but can detect steps for a wide variety of gait styles (Resnick, Nahm, Orwig, Zimmerman & Magaziner, 2001). When compared with the Sportline electronic, digital pedometer the step activity monitor had less error in all activities (brisk walk, slow walk, ascend and descend stairs); with a mean absolute error of 0.54% compared to 2.82% for the pedometer (Shepard, Toloza, McClung & Schmalzried, 1999). A step activity was used to assess ambulatory activity in gait-impaired hemiparetic stroke patients, during 6 minute walking trials 98% of actual steps were recorded (Macko, Haeuber, Shaughness, Coleman, Boone, et al., 2002). Coleman, Smith, Boone, Joseph and Aguila (1999) observed adults with diabetic peripheral neuropathy over a walking course using the step activity monitor and observed step counts. On two different trials, two weeks apart the step activity monitor recorded 99.7% of steps taken. Bergman, Bassett and Klein (in review) determined that the StepWatch Step Activity Monitor3 accurately measures steps taken by older adults in an assisted-living facility during a 161 meter walk. A study that used a step activity monitor for long term activity monitoring (Resnick, et al., 2001) the researchers' randomly assigned two participants to wear the device for 6 hours, one for 8 hours and one for 48 hours. Along with wearing the step activity monitor the participants were asked to maintain an activity log. It was reported that in all four cases the step activity monitor closely matched the recorded activity in the diaries.

Measuring Physical Activity of Older Adults

Physical activity has been identified as a potentially modifiable risk factor relating health and functional status among older adults (Heckler, 1985). There are consistent reports that older adults are less active when compared to the general population (Stephens, Jacobs & White, 1985; Caspersen, Christenson & Pollard, 1986) and that the decline may relate to the increased prevalence of chronic disease (Rauramaa, 1984; Albanes, Blair & Taylor, 1989). Caspersen, Merritt and Stephens (1994) suggested that men actually become more active after the age of 75, using data on U.S. men from the 1985 National Health Interview Study and basing energy expenditure on a relative scale. They concluded that studies have overestimated the decline in physical activity at older ages because they have used the same absolute standards of the rate of energy expenditure for young and old, despite the fact that an individual's rate of energy expenditure declines linearly with increasing age (Caspersen, et al., 1994). Imprecise measurement techniques for collecting physical activity data among older adults might add to the observed decrease in physical activity (Washburn, Jette & Janney, 1990). To further evaluate the relationship between physical activity and health, valid and reliable measures for individuals over the age of 65 need to be developed.

One-hundred twenty-five older adults living independently and in supervised rest homes were recruited to report frequency of participation in fifteen activities listed on The Activity Questionnaire of Holbrook and Skilbeck (1983) as a measurement of physical activity. Independence was measured with the Incapacity Index of Shanas (1968). It is a quantitative measure of an older adult's ability to perform the minimal tasks needed to remain independent. Strength, flexibility and cardiorespiratory fitness measurements were determined. Independent living individuals showed greater flexibility, activity levels and choice of walking speed than there dependent counterparts (Cunningham, Paterson, Himann, & Rechnitzer, 1993).

In 1992 only the Modified Baecke Questionnaire for Older Adults (Voorrips, Ravelli, Dongelmans, Deurenberg & Van Staveren, 1991) and the Zutphen Physical Activity Questionnaire (Caspersen, Bloemberg, Saris, Merritt & Kromhout, 1991) physical activity questionnaires had been validated in the older adult population (Caspersen, et al., 1991; Westerterp, Saris, Bloemberg, Kempen, Caspersen & Kromhout, 1992). Household activities were not included in the Zutphen Physical Activity Questionniare and the Modified Baecke Questionnaire for Older Adults did not assess walking or bicycling and had a one-year recall period (Stel, Smit, Pluijm, Visser, Deeg & Lips, 2004). Because of these limitations the Longitudinal Aging Physical Activity Questionnaire (LAPAQ) was developed based on both the Modified Baecke Questionnaire for Older Adults and the Zutphen Physical Activity Questionnaire (Stel, et al., 2004). To validate the LAPAQ participants completed a seven-day activity diary and wore the Yamax Digi-Walker pedometer. High correlation were reported between the LAPAQ and diary (r = 0.68); with moderate correlation with the pedometer (r = 0.56). Participants also reported that the LAPAQ was easier to use then either the diary or pedometer (Stel, et al., 2004).

The Yale Physical Activity Survey (YPAS) was designed to collect activity data in healthy older adult populations (Dipietro, Caspersen, Ostfeld & Nadel, 1993). In a two-week reliability and validity study the YPAS demonstrated adequate repeatability (r = 0.42 to 0.65) and some validity with several physiologic variables that reflect physical activity: weekly energy expenditure (r = -0.47), daily hours sitting (r = 0.53) and estimated VO_{2max} (r = 0.58) (Dipietro, et al., 1993). A sample of fifty-nine older adults was used to determine associations of the YPAS with the PAR and physiologic measures (estimated VO_{2max}, resting pulse rate, body mass index). The PAR is a standard, well-validated instrument and was designed to estimate energy expenditure in adults, including older-aged individuals (Blair, Haskell, Ho, Paffenbarger, Uranizan, et al., 1985). Weekly energy expenditure, total time in activity, summary index, time in moderate activity and vigorous index were all significantly correlated between the YPAS and PAR (Young, Jee & Appel, 2001). VO_{2max} and body mass index correlated with the summary, moving and standing indices. Moderate intensity and vigorous intensity activity indices from the YPAS correlated with the corresponding measures of the PAR (Young, et al., 2001).

Questionnaires may not be sensitive enough to detect small differences in the level of physical activity where the general level of activity is minimal. It is important to establish the effectiveness of objectives measures of physical activity among older adults. Caltrac accelerometers were tested for validity by comparing physical activity readings against the activity diaries of forty-five older individuals (Washburn, Janney & Fenster, 1990). Over three consecutive weekdays Caltrac readings were positively associated with the percent time engaged in walking, sport and recreation and time standing (r = 0.28) (Washburn, et al., 1990). Miller, et al (1994) reported low validity and reliability when comparing the Caltrac to five questionnaires.

Petrella and Cress (2004) assessed daily ambulation with a DigiWalker Stepcounter on community-dwelling older adults categorized into high functioning and low functioning groups. The high functioning group took significantly more steps per day and reported modifying fewer tasks. It is not clear if physical decline is due to lower physical activity levels or if lower physical activity levels enhance the declines in physical functioning (Petrella and Cress, 2004).

Measuring Physical Activity of Older Adults in Long-Term Care Facilities

Older adults in nursing homes may be particularly inactive, spending only 20% of their waking time being physically active (MacRae, Schnelle, Simmons & Ouslander, 1996). Lack of data on the physical activity levels of long-term care residents may be due to difficulties inherent in collecting data from nursing home residents. In field settings activity behaviors are based on information obtained by self-report, behavior observations, oxygen consumption, motion sensors or a combination of these methods. Most of these techniques are difficult to use with long-term care residents and the low levels of activity present a measurement challenge (Tudor-Locke & Myers, 2001).

Two physical activity questionnaires, the Seven-day Recall Physical Activity Questionnaire (Blair, et al., 1985) and Stanford Usual Activity Questionnaire (Sallis, et al., 1985), were used to assess activity in one-hundred and fifty residents in long-term care homes and one-hundred and sixty community-dwelling older adults. This data was used to describe the correlates of quality of life in these two samples. Lack of physical activity was a primary predictor of decreased quality of life in community-dwelling older adults. For institutionalized participants physical activity was less important with the role of disease dominant (Borowiak & Kostka, 2004).

Wandering behavior of participants in two long-term care setting was studied by direct observation and Large-scale integrated (LSI) activity monitors of a three-day period. LSIs have been validated of measuring frequency of movement when compared to activity logs (LaPorte, Kuller, Kupfer, McPartland, Matthews & Casperson, 1979). Algase, Kupferschmid, Beel-Bates and Beattie (1997) concluded that the LSI meters worn at the ankle for long intervals can index wandering behavior in long-term care residents.

Four ambulation measuring devices were selected to evaluate pacing behavior in nursing home residents. Two accelerometers, Mini-Motionlogger Actigraph and Personal Activity Meter (PAM), a Step Sensor and the Heartline pedometer were the instruments chosen for this study. Residents were observed for a ten-minute period once an hour for twelve hours for each of the devices. All instruments yielded high correlations with the observed number of steps and were tolerated by the residents. The Heartline pedometer and Step Sensor were rated the easiest to use (Cohen-Mansfield, Werner, Culpepper, Wolfson & Bickel, 1997). MacRae, et al (1996) used time-sample observations and Caltrac motion sensors to describe activity levels of ambulatory nursing home residents. Physically restrained and unrestrained residents were categorized as inactive, only expending 5.9 kcal/hour and 4.4 kcal/hour, respectively. For both groups fall risk was identified as a significant predictor of physical activity.

When tested on nursing home residents, Yamax pedometers significantly underestimated steps taken at slow, normal and fast paces over a 13 meter course. The instrument failed to detect 74% (slow), 55% (normal) and 46% (fast) of actual steps taken (Cyarto, Myers and Tudor-Locke, 2004). Yamax pedometers also significantly underestimated steps taken by assisted-living residents over a 161 meter distance by approximately 50% (Bergman, Bassett & Klein, in review). Participants walked at an average speed of 42 $m \cdot min^{-1}$. During this same study the StepWatch Step Activity

Monitor3, worn at the ankle, was determined to accurately measures steps taken by older adults residing in an assisted-living facility (Bergman, et al., in review).

Cognitive impairments are common in many long-term care residents and often threaten the validity of self-report methods. Limitations to these approaches include recall bias (Sallis & Saelens, 2000) and insensitivity to incidental daily walking behaviors (Ainsworth, Leon, Richardson, Jacobs, & Paffenbarger, 1993; Richardson, Leon, Jacobs, Ainsworth & Serfass, 1994). More invasive activity monitoring methods such as heart rate monitors and oxygen consumption would not be tolerated by many of these residents. The use of an objective monitoring device may be the most valid and reliable technique available to document the physical activity of long-term care residents.

Conclusion

Older adults have more health problems than do younger adults, and these tend to be more complex and chronic in nature. The percentage of the older adult population is rapidly increasing and there is a propensity to lose physical function and decrease the amount of daily physical activity performed as individuals age. Negative health consequences from being physically inactive are extensive. Physical activity promotion may be especially critical to combat the decline of functional status in older adults. Public health efforts are needed for improving lifestyle behaviors and efforts to promote physical activity may provide the largest overall benefit for public health. Physical activity has positive effects on a variety of different conditions, each of which contributes independently to the public health burden of chronic disease.

Nearly 20% of older adults have physical and/or mental impairments and seek long-term care. Approximately $54 – 80 billion annually is contributed to disability costs for physical frailty in older adults (Clark, Carlson, Zemke, Frank, Patterson, et al., 1996). With the increase in the older adult population, the costs for physically and mentally impaired older adults will also increase. The economic and health related impact of extended longevity is immense. It is essential to implement programs for reducing frailty and increasing functional status in older adults.

While considerable research literature is available concerning measuring physical activity, proper amount of physical activity and benefits of physical activity, most of these studies focus on the general adult population. Few studies have focused physical activity in the older adult population especially those residing in long-term care facilities. It is the intent of this study to address the need for measuring physical activity in older adults living in various care level facilities. Measuring physical activity and functional status, ADLs and IADLs, in institutionalized older adults will add to the research literature, provide insight for future research and give guidance to physical activity programs involving older adults.

APPENDIX B

SUPPLEMENTAL BIBLIOGRAPHY

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APPENDIX C

RECOMMENDATIONS FOR FUTURE RESEARCH

Future research must be conducted to determine the relationship between physical activity and function in older adult populations. Areas in which future studies may detail further detail the association introduced in the current study include the following:

1) Collect physical activity data at multiple points over a period of time.
2) Establish and use functional tests for older individuals who are severely impaired.
3) Use multiple instruments to collect physical activity and functional status data.
4) Assess physical activity of older adults in multiple settings.
5) Assess physical activity of older adults from diverse cultural identities.
6) Validate a physical instrument for dementia patients.
7) Monitor depression changes over time.
8) Increase the number of participants.

APPENDIX D

STUDY IN RETROSPECT

This study focused on health with regard to physical activity and functional status of older adults residing in long-term care. This concentration is primarily due to the interest of the investigator, direction of the dissertation committee, importance of physical activity and lack of physical activity research on older adults. The percentage of older adults in the United States population is rapidly increasing. Currently, 12% of the population is 65 years of age or older. By 2020 individuals 65 years and older are expected to reach 16.3% of the population. In 2050, that percentage will increase to 20.7%, with 5.0% 85 years of age and older (Administration on Aging, 2004).

The goal of this particular research project was simple, to find a relationship that may exist between number of steps, functional capacity and level of care. However, the difficultly of getting such information started early in this endeavor. Fortunately, the researcher had previous experience in working with older adults in assisted-living facilities and thus some of the difficulty was diminished.

Early in the process problems with Institutional Review Board approval hindered the start of data collection. Once approval was received, issues with recruiting participants who fit a set criterion for participation started. The staff at Shannondale was extremely helpful, kind and motivating. Without their assistance with recruitment and data collection this project would have taken much longer and been much tougher to complete. After identifying possible participants the challenge of getting them to participate and sign a consent form began. Some of the individuals did not have their own power of attorney. Therefore, the individual holding the power of attorney had to be contacted, informed about the study and counter-sign for the resident if they approved of their participation.

With the start of data collection many problems arouse. Because of the limited number of StepWatches scheduling participants to wear the device for a day soon became a problem. Working with the nurses' and nurse's aids to attach the devices in the morning and remove them at night was the biggest challenge faced. Many of them complied with no reminders but a few would constantly forget to put the devices on, setting my data collection period back a day.

Despite all the problems and frustrations, none were insurmountable; the research proceeded on schedule and was completed as planned. The best part of the entire project was getting to know the residents. They seemed to enjoy the company and would asked questions about the project every time. Although it was sometimes frustrating spending an hour with one of the residents when all that was needed was fifteen minutes, in the end that is what had the greatest impact.

At some point in time, the majority of us will reach an age for which we will be categorized as older adults. Short of dying, there is no way to prevent this; it is inevitable. What we can do and learn now to better prepare for that time is very important.

APPENDIX E

FORMS

PARTICIPANT COVER LETTER

March 2005

Dear Prospective Participant

This letter is written to invite you to participate in a study to measure activities of daily living, instruments used to perform daily tasks, and the number of steps taken during the day. Participation is voluntary and if you decide to participate, the study will cover a two-day period.

On Day 1 survey questions will be read to you by the researcher and your responses will be recorded. The surveys will take no more than 30 minutes of your time. Day 2 involves wearing a step counter that will measure steps taken during a full day, waking up until bedtime, and will not require any activities beyond what you normally do on any other day. The attached "informed consent" explains the study in detail. If you will be participating in the study, completed consent forms should be returned to Peggy Smith, Susan Dutton or Karen Guthrie.

If you have any questions concerning this study, please contact me at (865) 974-4215. Thank you for your cooperation and participation.

Sincerely,

Randall J. Bergman
Graduate Student

INFORMED CONSENT

STEPS PER DAY FOR OLDER ADULTS
RESIDING IN DIFFERENT LEVELS OF CARE

Investigator:
Randall J. Bergman
Address:
The University of Tennessee
Health and Safety Programs
1914 Andy Holt Ave. Room 383
Knoxville, TN 37996
Telephone:
865-974-4215

Purpose

You are invited to participate in a research study. The purpose of this study is to examine number of steps taken by older adults in different levels of long-term care. If you give your consent, you will be asked to participate in this study.

Procedures

- **Part 1**. Day 1. You will be asked to give demographic information (age, height, weight, race, education, marital status, perceived general health status, income before assistance, current payment method, diseases/ disabilities, number of medications, time in community, level of care, time in level of care, level of care moved from, and why moved into current level of care), respond to questions from the Activities of Daily Living (ADL) - (can you eat, can you walk, can you bathe, do you have trouble making it to the restroom; and Instrumental Activities of Daily Living (IADL) - can you use the telephone, can you prepare your own meals, can you handle your money, questionnaires. These questions pertain to normal daily activities and personal care; instruments used to perform daily tasks, ability to maintain a safe and clean household and will be asked verbally by the principal investigator. If you unable to provide any or some of this information it will be collected from facility records. The testing will require a total of about 30 minutes of your time.
- **Part 2**. Day 2. You will be asked to wear the StepWatch3 Activity Monitor for a full day (from waking up until bedtime). You will not be asked to do any activities beyond which you would normally do on any other day. The monitor will be attached to your right ankle when you awake in the morning and removed when you go to bed that night. Remove the activity monitor when bathing, reattaching it when done. You will be given instructions on how to attach and use the activity monitor.

Risks and Benefits

You will not be doing anything more than normal daily activities. The risks are equivalent to daily walking and movement. Proper facility procedures will be followed for your care in the case of a fall during normal daily activities. In the event of an injury the University of Tennessee does not automatically reimburse participants for medical claims or other compensation. Benefits include how walking can improve health and exposure to a device that might facilitate more physical activity.

Confidentiality

The information from these tests will be treated as privileged and confidential and will not be released to any person without your consent. However, the information will be used in research articles or presentations, but your name and other identifying information will not be disclosed.

Right to Ask Questions and to Withdraw

You are free to decide whether or not to take part in this study and are free to leave the study at any time. Your participation in this study is completely voluntary.

Before you sign this form, please ask questions about any aspects of the study, which are unclear to you.

Compensation

I will not be paid for my participation in the study.

Consent

By signing this paper, I am indicating that I understand and agree to take part in this research study.

________________________ ________________________

Your signature Date

________________________ ________________________

Investigator's signature Date

________________________ ________________________

Power of Attorney (if applicable) Date

Data Collection

Name: ____________________ ID#:______________________
Room #: _________

ID # __________________ Date _________________

Level of Care___________ Age _____________

Gender _______________ Height _____________

Weight _____________ BMI _____________

Race _____________ Walking assistance ___________

Facility cost/month ____________

Education: Not graduate from high school Graduated from high school

Some college Graduated from college Post-Graduate

Marital Status: Married Widowed Separated/Divorced Never Married

Pay type: Medicare Medicaid Private

Medicated: Yes No How many __________

Household Income per year before assistance: (in thousands)

Under 20 20-40 40-60 60-80 80-100 More than 100

Time in community _____________ Time in level of care ____________

Why moved into level of care ____

Moved from (level of care) ____

Disabilities / Diseases:

SW Steps _____________ Date:_______ Time on: ________ Time off: _______

ADL _____________ IADL _____________

Permission Letter

Information from the
CENTER FOR THE STUDY OF AGING
AND
HUMAN DEVELOPMENT

Harvey J. Cohen, M.D., Director

November 25, 2004

Randy Bergman
820 West Hill Ave., Apt. 203
Knoxville TN 37902

Dear Mr. Bergman:

You have our permission to reproduce and use the OARS ADL and IADL scales for your dissertation research as stated in your email of November 22. We have one requirement and one suggestion. The requirement is that you include a notification on the face of all reproductions of the scales that they are the OARS ADL and IADL Scales (copyrighted), which are being reproduced with permission.

The appropriate citation is:

Fillenbaum GG. Multidimensional functional assessment of older adults: The Duke Older Americans Resources and Services Procedures. Lawrence Erlbaum Associates, Hillsdale, New Jersey, 1988.

The suggestion is that you keep in touch with us as your work progresses. There are multiple users of the OARS/MFAQ nationwide. You may want to be in touch with other users with interests similar to your own.

The person with whom you would correspond in the future about OARS is Dr. Gerda Fillenbaum. You can write to her at Box 3003, Duke University Medical Center, Durham, NC 27710, or e-mail ggf@geri.duke.edu

Sincerely,

Harvey Jay Cohen, M.D.
Professor of Medicine,
Aging Center Director and
Chief, Geriatrics Division
Associate Chief of Staff for
Geriatrics and Extended Care and
Director, GRECC, VAMC

Coding for Dissertation

Level of Care: 1 – Retirement Home 2- Assisted-living 3- Nursing Home

Gender: 1 – male 2 - female

Race: 1 – Caucasian 2 – African American 3 – Hispanic

4 - Other

Walking assistance: 1 – none 2 – cane 3- walker 4 –wheel chair

Education: 1 - Not graduate from high school2 - Graduated from high school

3 - Graduated from college

Marital Status: 1 - Married 2 – Widowed 3- Single

Pay type: 1 – Medicaid/Medicare 2 – Private

Medicated: 1 - Yes 2 - No

Perceived Health Status: 1 – Poor 2 – Fair 3- Good 4 – Excellent

Household Income per year before assistance: (in thousands)

1 - Under 40 2 – 40 – 80 3 – 80 and over

Time in current level of care (months):

1 – 0 – 24 2 – 25 – 48 3 – 49 and over

Moved from (level of care): 1 – Long-term care facility 2 -community dwelling

3-hosiptal/community

ADL problems: 0 – No 1 – Mild 2 – Moderate 3 – Severe

4 - Total

ADL impairment: 2 – Excellent/Good 3 – Mild 4 – Moderate 5 – Severe

6 – Total

APPENDIX F

QUESTIONNAIRES

OARS Questionnaire Forms

(from Duke University Center of Geriatrics)
Activities of Daily Living (ADL)

1. Can you eat…
   - 2 without help (able to feed yourself completely),
   - 1 with some help (need help with cutting, etc.),
   - 0 or are you completely unable to feed yourself?
   - \- Not answered

2. Can you dress and undress yourself…
   - 2 without help (able to pick out clothes, dress and undress yourself),
   - 1 with some help,
   - 0 or are you completely unable to dress and undress yourself?
   - \- Not answered

3. Can you take care of your own appearance, for example combing your hair and (for men) shaving…
   - 2 without help,
   - 1 with some help,
   - 0 or are you completely unable to maintain your appearance?
   - \- Not answered

4. Can you walk…
   - 2 without help (except from a cane),
   - 1 with some help from a person or with the use of a walker, or crutches, etc.,
   - 0 or are you completely unable to walk?
   - \- Not answered

5. Can you get in and out of bed…
   - 2 without any help or aids,
   - 1 with some help (either from a person or with the aid of some device),
   - 0 or are you totally dependent on someone else to help you?
   - \- Not answered

6. Can you take a bath or shower…
   - 2 without help,
   - 1 with some help (need help getting in and out of tub or need special attachments on the tub),
   - 0 or are you completely unable to bathe yourself?
   - \- Not answered

7. Do you ever have trouble getting to the bathroom on time?

    2 No
    1 Yes
    0 Have a catheter or colostomy
    - Not answered

    (If "YES", ask a.)

    a. How often do you wet or soil yourself (either day or night)?

        1 Once or twice a week
        0 Three times a week or more
        - Not answered

8. Is there someone who helps you with such things as shopping, housework, bathing, dressing, and getting around?

    1 Yes
    0 No
    - Not answered

OARS Questionnaire Forms

(from Duke University Center of Geriatrics)
Instrumental Activities of Daily Living (IADL)

1. Can you use the telephone…
   - 2 without help, including looking up number and dialing,
   - 1 with some help (can answer or dial operator in an emergency, but need a special phone to help in getting the number or dialing),
   - 0 or are you completely unable to use the telephone?
   - \- Not answered

2. Can you get to places out of walking distance…
   - 2 without help (can travel alone on buses, taxis, or drive your own car),
   - 1 with some help (need someone to help you or go with you when traveling),
   - 0 or are you unable to travel unless emergency arrangements are made for a specialized vehicle like an ambulance?
   - \- Not answered

3. Can you go shopping for groceries or clothing [ASSUMING SUBJECT HAS TRANSPORTATION]…
   - 2 without help (taking care of all shopping needs yourself, assuming you have transportation),
   - 1 with some help (need someone to go with you on all shopping trips),
   - 0 or are you completely unable to do any shopping?
   - \- Not answered

4. Can you prepare your own meals…
   - 2 without help (plan and cook full meals yourself),
   - 1 with some help (can prepare some things but unable to cook full meals yourself),
   - 0 or are you completely unable to prepare any meals?
   - \- Not answered

5. Can you do your housework…
   - 2 without help (can scrub floors, etc.),
   - 1 with some help (can do light housework but need help with heavy work),
   - 0 or are you completely unable to do any housework?
   - \- Not answered

6. Can you take your own medicine…
   - 2 without help (in the right doses at the right time),
   - 1 with some help (able to take medicine if someone prepares if for you and/or reminds you to take it),
   - 0 or are you completely unable to take your medicines?
   - \- Not answered

7. Can you handle your own money…
   - 2 without help (write checks, pay bills, etc.),
   - 1 with some help (manage day-to-day buying but need help with managing your checkbook and paying your bills),
   - 0 or are you completely unable to handle money?
   - \- Not answered

APPENDIX G

STATISTICS

Table G1. Means, Standard Deviations and Minimum and Maximum Values

	Mean	Standard Deviation	Minimum	Maximum
Age	85.51	4.16	71	94
Height	64.68	3.57	59	72
Weight	140.95	27.19	98	203
BMI	23.90	3.61	16.8	32.8
Education Level	2.32	.78	1	3
Walking Assistance	2.16	1.32	1	4
Number of Medication	7.27	4.33	0	18
Perceived Health	2.54	.84	1	4
Income before Assistance	1.86	.63	1	3
Time in Level of Care	1.65	.79	1	3
Steps	6134.11	5205.60	8	21,530
ADL Problems	2.32	1.31	0	4
ADL Impairments	4.35	1.30	2	6

Table G2. Gender Frequencies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	11	29.7	29.7	29.7
	Female	26	70.3	70.3	100.0
	Total	37	100.0	100.0	

Table G3. Marital Status Frequencies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Married	11	29.7	29.7	29.7
	Widowed	20	54.1	54.1	83.8
	Single	6	16.2	16.2	100.0
	Total	37	100.0	100.0	

Table G4. Educational Level Frequencies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Graduated from High School	7	18.9	18.9	18.9
	Graduated from High School	11	29.7	29.7	48.6
	Graduated from College	19	51.4	51.4	100.0
	Total	37	100.0	100.0	

Table G5. Walking Assistance Frequencies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	20	54.1	54.1	54.1
	Walker	8	21.6	21.6	75.7
	Wheelchair	9	24.3	24.3	100.0
	Total	37	100.0	100.0	

Table G6. Pay Type Frequencies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Medicare/ Medicaid	17	45.9	45.9	45.9
	Private	20	54.1	54.1	100.0
	Total	37	100.0	100.0	

Table G7. Medicated Frequencies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	36	97.3	97.3	97.3
	No	1	2.7	2.7	100.0
	Total	37	100.0	100.0	

Table G8. Perceived Health Status Frequencies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Poor	4	10.8	10.8	10.8
	Fair	13	35.1	35.1	45.9
	Good	16	43.2	43.2	89.2
	Excellent	4	10.8	10.8	100.0
	Total	37	100.0	100.0	

Table G9. Income Before Assistance Frequencies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Under 40	10	27.0	27.0	27.0
	40 - 80	22	59.5	59.5	86.5
	80 and over	5	13.5	13.5	100.0
	Total	37	100.0	100.0	

Table G10. Time in Current Level of Care Frequencies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0 - 24	20	54.1	54.1	54.1
	25 - 48	10	27.0	27.0	81.1
	49 and up	7	18.9	18.9	100.0
	Total	37	100.0	100.0	

Table G11. Level of Care Moved From Frequencies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Long-term care facility	7	18.9	18.9	18.9
	Community dwelling	20	54.1	54.1	73.0
	Hospital/ Community	10	27.0	27.0	100.0
	Total	37	100.0	100.0	

Table G12. ADL Problems Frequencies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	2	5.4	5.4	5.4
	Mild	12	32.4	32.4	37.8
	Moderate	4	10.8	10.8	48.6
	Severe	10	27.0	27.0	75.7
	Total	9	24.3	24.3	100.0
	Total	37	100.0	100.0	

Table G13. ADL Impairments Frequencies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Excellent/Good	2	5.4	5.4	5.4
	Mild	11	29.7	29.7	35.1
	Moderate	5	13.5	13.5	48.6
	Severe	10	27.0	27.0	75.7
	Total	9	24.3	24.3	100.0
	Total	37	100.0	100.0	

Table G14. Descriptive Statistics for Steps

Level of care	Mean	Std. Deviation	N
Nursing Home	5117.17	5913.014	12
Assisted-living	2592.75	1961.688	8
Retirement Home	8518.47	4707.783	17
Total	6134.11	5205.601	37

Table G15. Tests of Between-Subjects Effects for Steps

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	209387912.166(a)	2	104693956.083	4.646	.016
Intercept	985789959.461	1	985789959.461	43.747	.000
Level	209387912.166	2	104693956.083	4.646	.016
Error	766150255.402	34	22533831.041		
Total	2367747612.000	37			
Corrected Total	975538167.568	36			

a R Squared = .215 (Adjusted R Squared = .168)

Table G16. Multiple Comparisons for Steps

Level of Care	Level of Care	Mean Difference	Std. Error	Significance
Nursing Home	Assisted-living	2524.42	2166.691	.482
	Retirement Home	-3401.30	1789.787	.154
Assisted-living	Nursing Home	-2524.42	2166.691	.482
	Retirement Home	-5925.72(*)	2035.251	.017
Retirement Home	Nursing Home	3401.30	1789.787	.154
	Assisted-living	5925.72(*)	2035.251	.017

* The mean difference is significant at the .05 level.

Table G17. Descriptive Statistics for ADL Problems

Level of care	Mean	Std. Deviation	N
Nursing Home	3.42	.669	12
Assisted-living	2.88	.991	8
Retirement Home	1.29	.985	17
Total	2.32	1.313	37

Table G18. Test of Between Subjects Effects for ADL Problems

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	34.787(a)	2	17.394	21.646	.000
Intercept	215.395	1	215.395	268.050	.000
Level	34.787	2	17.394	21.646	.000
Error	27.321	34	.804		
Total	262.000	37			
Corrected Total	62.108	36			

a R Squared = .560 (Adjusted R Squared = .534)

Table G19. Multiple Comparisons of ADL Problems

Level of Care	Level of Care	Mean Difference	Std. Error	Significance
Nursing Home	Assisted-living	.54	.409	.392
	Retirement Home	2.12(*)	.338	.000
Assisted-living	Nursing Home	-.54	.409	.392
	Retirement Home	1.58(*)	.384	.001
Retirement Home	Nursing Home	-2.12(*)	.338	.000
	Assisted-living	-1.58(*)	.384	.001

* The mean difference is significant at the .05 level.

Table G20. Descriptive Statistics for ADL Impairments

Level of care	Mean	Std. Deviation	N
Nursing Home	5.42	.669	12
Assisted-living	5.00	.756	8
Retirement Home	3.29	.985	17
Total	4.35	1.296	37

Table G21. Test of Between Subjects Effects for ADL Impairment

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	35.986(a)	2	17.993	25.025	.000
Intercept	703.653	1	703.653	978.651	.000
Level	35.986	2	17.993	25.025	.000
Error	24.446	34	.719		
Total	761.000	37			
Corrected Total	60.432	36			

a R Squared = .595 (Adjusted R Squared = .572)

Table G22. Multiple Comparisons for ADL Impairment

Level of Care	Level of Care	Mean Difference	Std. Error	Sig.
Nursing Home	Assisted-living	.42	.387	.535
	Retirement Home	2.12(*)	.320	.000
Assisted-living	Nursing Home	-.42	.387	.535
	Retirement Home	1.71(*)	.364	.000
Retirement Home	Nursing Home	-2.12(*)	.320	.000
	Assisted-living	-1.71(*)	.364	.000

* The mean difference is significant at the .05 level.

Table G23. Descriptive Statistics for Perceived Health Status

Level of care	Mean	Std. Deviation	N
Nursing Home	2.00	.739	12
Assisted-living	2.38	.744	8
Retirement Home	3.00	.707	17
Total	2.54	.836	37

Table G24. Tests of Between-Subjects Effects for Perceived Health Status

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	7.314(a)	2	3.657	6.956	.003
Intercept	203.591	1	203.591	387.249	.000
Level	7.314	2	3.657	6.956	.003
Error	17.875	34	.526		
Total	264.000	37			
Corrected Total	25.189	36			

a R Squared = .290 (Adjusted R Squared = .249)

Table G25. Multiple Comparisons for Perceived Health Status

Level of Care	Level of Care	Mean Difference	Std. Error	Sig.
Nursing Home	Assisted-living	-.38	.331	.501
	Retirement Home	-1.00(*)	.273	.002
Assisted-living	Nursing Home	.38	.331	.501
	Retirement Home	-.63	.311	.125
Retirement Home	Nursing Home	1.00(*)	.273	.002
	Assisted-living	.63	.311	.125

* The mean difference is significant at the .05 level.

Table G26. Descriptive Statistics for BMI

Level of care	Mean	Std. Deviation	N
Nursing Home	24.225	4.5490	12
Assisted-living	24.563	4.2912	8
Retirement Home	23.359	2.5241	17
Total	23.900	3.6064	37

Table G27. Tests of Between-Subjects Effects for BMI

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	9.758(a)	2	4.879	.362	.699
Intercept	19483.280	1	19483.280	1444.898	.000
Level	9.758	2	4.879	.362	.699
Error	458.462	34	13.484		
Total	21602.990	37			
Corrected Total	468.220	36			

a R Squared = .021 (Adjusted R Squared = -.037)

Table G28. Multiple Comparisons for BMI

Level of Care	Level of Care	Mean Difference	Std. Error	Sig.
Nursing Home	Assisted-living	-.338	1.6761	.978
	Retirement Home	.866	1.3845	.807
Assisted-living	Nursing Home	.338	1.6761	.978
	Retirement Home	1.204	1.5744	.727
Retirement Home	Nursing Home	-.866	1.3845	.807
	Assisted-living	-1.204	1.5744	.727

Table G29. Descriptive Statistics for Income Before Assistance

Level of care	Mean	Std. Deviation	N
Retirement Home	2.06	.748	17
Assisted-living	2.00	.000	8
Nursing Home	1.50	.522	12
Total	1.86	.631	37

Table G30. Tests of Between-Subjects Effects for Income Before Assistance

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2.383(a)	2	1.192	3.393	.045
Intercept	115.664	1	115.664	329.330	.000
Level	2.383	2	1.192	3.393	.045
Error	11.941	34	.351		
Total	143.000	37			
Corrected Total	14.324	36			

a R Squared = .166 (Adjusted R Squared = .117)

Table G31. Multiple Comparisons for Income Before Assistance

Level of Care	Level of Care	Mean Difference	Std. Error	Sig.
Retirement Home	Assisted-living	.06	.254	.971
	Nursing Home	.56(*)	.223	.045
Assisted-living	Retirement Home	-.06	.254	.971
	Nursing Home	.50	.270	.169
Nursing Home	Retirement Home	-.56(*)	.223	.045
	Assisted-living	-.50	.270	.169

* The mean difference is significant at the .05 level.

Table G32. Descriptive Statistics for Education Level

Level of care	Mean	Std. Deviation	N
Nursing Home	1.75	.866	12
Assisted-living	2.75	.463	8
Retirement Home	2.53	.624	17
Total	2.32	.784	37

Table G33. Test of Between-Subjects Effects for Education Level

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6.123(a)	2	3.061	6.511	.004
Intercept	184.957	1	184.957	393.396	.000
Level	6.123	2	3.061	6.511	.004
Error	15.985	34	.470		
Total	222.000	37			
Corrected Total	22.108	36			

a R Squared = .277 (Adjusted R Squared = .234)

Table G34. Multiple Comparisons for Educational Level

Level of Care	Level of Care	Mean Difference	Std. Error	Sig.
Nursing Home	Assisted-living	-1.00(*)	.313	.008
	Retirement Home	-.78(*)	.259	.013
Assisted-living	Nursing Home	1.00(*)	.313	.008
	Retirement Home	.22	.294	.735
Retirement Home	Nursing Home	.78(*)	.259	.013
	Assisted-living	-.22	.294	.735

* The mean difference is significant at the .05 level.

Table G35. Descriptive Statistics for Martial Status

Level of care	Mean	Std. Deviation	N
Nursing Home	1.92	.669	12
Assisted-living	2.13	.354	8
Retirement Home	1.71	.772	17
Total	1.86	.673	37

Table G36. Tests of Between-Subjects for Martial Status

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1.003(a)	2	.502	1.113	.340
Intercept	123.651	1	123.651	274.403	.000
Level	1.003	2	.502	1.113	.340
Error	15.321	34	.451		
Total	145.000	37			
Corrected Total	16.324	36			

a R Squared = .061 (Adjusted R Squared = .006)

Table G37. Multiple Comparisons for Martial Status

Level of Care	Level of Care	Mean Difference	Std. Error	Sig.
Nursing Home	Assisted-living	-.21	.306	.777
	Retirement Home	.21	.253	.686
Assisted-living	Nursing Home	.21	.306	.777
	Retirement Home	.42	.288	.324
Retirement Home	Nursing Home	-.21	.253	.686
	Assisted-living	-.42	.288	.324

Table G38. Descriptive Statistics for Walking Assistance

Level of care	Mean	Std. Deviation	N
Nursing Home	2.67	1.497	12
Assisted-living	3.13	.354	8
Retirement Home	1.35	.996	17
Total	2.16	1.323	37

Table G39. Tests of Between-Subjects Effects for Walking Assistance

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	21.603(a)	2	10.802	8.866	.001
Intercept	191.069	1	191.069	156.826	.000
Level	21.603	2	10.802	8.866	.001
Error	41.424	34	1.218		
Total	236.000	37			
Corrected Total	63.027	36			

a R Squared = .343 (Adjusted R Squared = .304)

Table G40. Multiple Comparisons for Walking Assistance

Level of Care	Level of Care	Mean Difference	Std. Error	Sig.
Nursing Home	Assisted-living	-.46	.504	.638
	Retirement Home	1.31(*)	.416	.009
Assisted-living	Nursing Home	.46	.504	.638
	Retirement Home	1.77(*)	.473	.002
Retirement Home	Nursing Home	-1.31(*)	.416	.009
	Assisted-living	-1.77(*)	.473	.002

* The mean difference is significant at the .05 level.

Table G41. Descriptive Statistics for Number of Medications

Level of care	Mean	Std. Deviation	N
Nursing Home	9.33	2.774	12
Assisted-living	7.88	6.402	8
Retirement Home	5.53	3.502	17
Total	7.27	4.325	37

Table G42. Tests of Between-Subjects Effects for Number of Medications

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	105.520(a)	2	52.760	3.159	.055
Intercept	1935.212	1	1935.212	115.886	.000
Level	105.520	2	52.760	3.159	.055
Error	567.777	34	16.699		
Total	2629.000	37			
Corrected Total	673.297	36			

a R Squared = .157 (Adjusted R Squared = .107)

Table G43. Multiple Comparisons for Number of Medications

Level of Care	Level of Care	Mean Difference	Std. Error	Sig.
Nursing Home	Assisted-living	1.46	1.865	.717
	Retirement Home	3.80(*)	1.541	.048
Assisted-living	Nursing Home	-1.46	1.865	.717
	Retirement Home	2.35	1.752	.384
Retirement Home	Nursing Home	-3.80(*)	1.541	.048
	Assisted-living	-2.35	1.752	.384

* The mean difference is significant at the .05 level.

Table G44. Spearman's Rho Correlations

		Steps	ADLP	ADLI	Health	Income
Level	Coefficient	-.404*	.730*	.747*	-.530*	-.360*
	Sig.	.013	.000	.000	.001	.028
Steps	Coefficient	1.00	-.587*	-.621*	-.346*	.108
	Sig.		.000	.000	.036	.523
ADLP	Coefficient	-.587*	1.00	.992*	-.616*	-.166
	Sig.	.000		.000	.000	.326
ADLI	Coefficient	- .621*	.992*	1.00	.610*	-.166
	Sig.	.000	.000		.000	.326
Health	Coefficient	.346*	-.616*	-.610*	1.00	.176
	Sig.	.000	.000	.000		.297
Income	Coefficient	.108	-.166	-.166	.176	1.00
	Sig.	.523	.326	.326	.297	
Education	Coefficient	-.018	-.256	-.240	.211	.362*
	Sig.	.916	.127	.153	.211	.028
Number	Coefficient	-.076	.426*	.406*	-.481*	-.031
	Sig.	.655	.009	.013	.003	.853

Table G45. Spearman's Rho Correlations Continued

		Education	Number
Level	Coefficient	-.364*	.422*
	Sig.	.027	.009
Steps	Coefficient	-.018	-.076
	Sig.	.916	.655
ADLP	Coefficient	-.256	.426*
	Sig.	.127	.009
ADLI	Coefficient	-.240	.406*
	Sig.	.153	.013
Health	Coefficient	.211	-.481*
	Sig.	.211	.003
Income	Coefficient	.362*	-.031
	Sig.	.028	.853
Education	Coefficient	1.00	.088
	Sig.		.603
Number	Coefficient	.088	1.00
	Sig.	.603	

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